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Nuclear Energy: Kentucky's New Coal?

Katie Haagen
University of Kentucky

NUCLEAR ENERGY: KENTUCKY'S NEW COAL?

*Katie Haagen**

INTRODUCTION

Nationally, Kentucky is known as "The Bluegrass State"; for many Kentuckians, however, it is known as Coal Country. Despite the fact that the rest of the economy continues to grow, the coal industry is fading.[1] Coal production in Kentucky is at its lowest since 1939.[2] Residents of both Eastern and Western Kentucky are searching for jobs and even returning to school after being laid off from their jobs at coal mines.[3] While the industry rapidly declines, many wonder where Kentucky will turn when coal is gone for good. One of the most promising alternatives to coal in Kentucky is nuclear energy. Often overlooked in favor of other forms of alternative energy like wind, solar, and geothermal power, nuclear energy is a clean, semi-renewable resource with a promising future.

Currently, there are no operating nuclear reactors located within Kentucky.[4] Nationwide, there are 104 commercial nuclear power plants producing a whopping 806.2 TWh (terawatt hours) of electricity, equaling around twenty percent of overall electricity generation.[5] Nuclear plants in Tennessee and Alabama, located

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* Production Editor, KENTUCKY JOURNAL OF EQUINE, AGRICULTURE, & NATURAL RESOURCES LAW, 2017-2018; B.A. 2015, Western Kentucky University; J.D. expected May 2018, University of Kentucky.

[1] Steve Inskeep, *In Kentucky, the Coal Habit is Hard to Break*, NPR (Jan. 12, 2016, 5:11 AM), http://www.npr.org/2016/01/12/462695139/in-kentucky-coal-country-a-mining-life-in-flux.

[2] *Kentucky Quarterly Coal Report*, KY. ENERGY AND ENV'T CABINET: DEP'T FOR ENERGY DEV. AND INDEP. (Apr. 29,. 2016), https://energy.ky.gov/Coal%20Facts%20Library/Kentucky%20Quarterly%20Coal%20Report%20(Q1-2016).pdf.

[3] *See* Bill Estep, *Coal Jobs in Kentucky Fall to Lowest Level in 118 Years*, LEXINGTON HERALD LEADER (May 2, 2016, 8:01 AM), http://www.kentucky.com/news/state/article75087302.html [https://perma.cc/43AF-HQ4Y].

[4] *See NRC: Kentucky*, U.S. NUCLEAR REGULATORY COMM'N, http://www.nrc.gov/info-finder/region-state/kentucky.html (last updated June 30, 2015) [https://perma.cc/E5EV-NKJX].

[5] *Nuclear Energy In the United States*, JJC, http://www3.jjc.edu/ftp/wdc11/jdobrzynski/NE_USA_1.html (last visited Sept. 7, 2017) [https://perma.cc/S5DB-ATQB].

right in Kentucky's back yard, produce low-cost, clean, and reliable energy that powers more than 4.5 million homes and businesses.[6] Kentucky is capable of building and supporting a nuclear power plant, and with the recent passage of Senate Bill 89, there has never been a more pressing time to do so.[7] Not only does nuclear energy production result in more clean-air energy than any other, but it is also the only energy source able to produce electricity 24 hours a day.[8] Also, "[n]uclear energy produces sixty-four percent of all U.S. emission-free electricity."[9]

Fear of nuclear meltdowns persists globally as a result of events like the Chernobyl meltdown in 1986 and the Fukushima meltdown in 2011.[10] But countless safety measures are taken at nuclear power plants. In 2015, nuclear power plants had 0.03 industrial safety accidents per 200 thousand worker-hours.[11]

The benefits of nuclear energy are numerous and impressive, including relatively low operating costs, low pollution, sustainability, and high-density energy.[12] Nuclear energy's drawbacks, however, include high startup costs, laborious radioactive waste management, and the small yet nonexistent possibility of accidents.[13] When given a cost-benefit analysis, however, the benefits of adopting nuclear energy outweigh its pitfalls. The possibility of reducing carbon emissions,

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[6] *See Nuclear*, TENN. VALLEY AUTH., https://www.tva.gov/Energy/Our-Power-System/Nuclear (last visited Oct. 25, 2016) [https://perma.cc/7LTX-RBLY].

[7] *Kentucky Senate Approves Nuclear Power Bill*, THE LANE REPORT (Mar. 2, 2016), http://www.lanereport.com/60883/2016/03/kentucky-senate-approves-nuclear-power-bill/ [https://perma.cc/82L3-7TAN].

[8] *Quick Facts: Nuclear Energy in America*, NUCLEAR ENERGY INST. (Jul. 2014), https://nei.org/CorporateSite/media/filefolder/Backgrounders/Fact-Sheets/Quick-Facts-July-2014.pdf?ext=.pdf [https://perma.cc/C2B3-NLP3].

[9] *Id.*

[10] *See* Jennie Cohen, *History's Worst Nuclear Disasters*, HISTORY (Mar. 18, 2011), http://www.history.com/news/historys-worst-nuclear-disasters [https://perma.cc/T38S-Y2AC].

[11] *Safety: The Nuclear Energy Industry's Highest Priority*, NUCLEAR ENERGY INST. (June 2015), https://www.nei.org/Master-Document-Folder/Backgrounders/Fact-Sheets/Safety-The-Nuclear-Energy-Industry-s-Highest-Prior [https://perma.cc/YT8F-Q5K3].

[12] *See Quick Facts: Nuclear Energy in America*, *supra* note 9.

[13] *See FAQ About Nuclear Energy*, NUCLEAR ENERGY INST., https://www.nei.org/Knowledge-Center/FAQ-About-Nuclear-Energy (last visited Sept. 7, 2017) [https://perma.cc/4MHN-U883]..

creating jobs, and improving Kentucky's economy is too striking to pass up.

In a battle against coal, nuclear energy easily has the upper hand. If Kentucky were to construct a nuclear power plant that rivaled TVA's Watts Barr II in Tennessee, the plant could create over 5 thousand jobs resulting in an estimated 400 million dollar economic impact.[14] Meanwhile, coal jobs are disappearing at an alarming rate as coal becomes more expensive to produce.[15] Combatting climate change and reducing carbon emissions are at the top of a long list of reasons to eliminate coal. Nuclear power releases a fraction of carbon dioxide into the atmosphere compared to coal, preventing many human deaths.[16] If Kentucky wants to jumpstart its economy, reduce emissions, and create jobs for its residents, moving away from coal is the only way to go.

This Note explores the economic and environmental effects replacing coal with nuclear energy could have on Kentucky. Part I discusses the pros and cons of establishing a nuclear power plant in Kentucky, including discussions regarding startup and running costs of a plant, the benefits and pitfalls of nuclear energy, and the legal issues surrounding the building of a nuclear power plant within Kentucky. Part II discusses the battle between coal and nuclear energy and their respective effects on the state. Additionally, this part discusses job creation and replacement after the closing of coal mines, radioactive waste storage comparison, and analysis of future revenue from both coal mining and nuclear energy in Kentucky. Part III will examine the effects of both establishing nuclear energy in Kentucky and the elimination of coal mining, including the effects on rural families,

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[14] Dan Yurman, *Can Coal State Kentucky Embrace Nuclear Energy?*, NEUTRON BYTES (Sept. 20, 2015), https://neutronbytes.com/2015/09/20/can-coal-state-kentucky-embrace-nuclear-energy/ [https://perma.cc/LFY6-9G7T].

[15] *See* Maria Galluci, *Kentucky Split Between Coal Past and Clean Energy Future*, THE GUARDIAN (Feb. 25, 2011), https://www.theguardian.com/environment/2011/feb/25/kentucky-coal-clean-energy [https://perma.cc/557E-JRZM].

[16] *See* Pushker Kharecha & James Hansen, *Coal and Gas are Far More Harmful than Nuclear Power*, NASA (Apr. 22, 2013), http://climate.nasa.gov/news/903/coal-and-gas-are-far-more-harmful-than-nuclear-power/ [https://perma.cc/QL3Q-5CN4].

climate change, and economic growth. Collectively, all three parts demonstrate that if Kentucky continues to put all of its eggs in coal's basket, it will be left behind as neighboring states surge forward toward nuclear power.[17]

I. ESTABLISHING NUCLEAR ENERGY IN KENTUCKY: PROS AND CONS

Establishing a new nuclear power plant is not a short process. In a competitive electricity market, there are three steps to construction: (1) filing an application for a combined U.S. Nuclear Regulatory Commission license, which would allow a company to build and operate a nuclear plant, provided the facility conformed to approved specifications; (2) procuring major long-lead components and commodities; and (3) proceeding with construction.[18]

The industry is continuously at work with large capital projects in an effort to maintain and refurbish the ninety-nine existing reactors.[19] Industry-implemented upgrades at many plants have boosted the amount of electricity the plants can produce.[20] The Nuclear Energy Institute gives an example, where "the Tennessee Valley Authority refurbished the Browns Ferry I reactor in a five-year, $1.9 billion project, on schedule and within budget."[21] After over thirty years of being shut down, this specific reactor was able to be quickly restarted in 2007 and now provides electricity to 800 thousand homes.[22]

Determining a location for a nuclear energy plant is perhaps the most important step in establishing nuclear energy in Kentucky. Energy companies look at various factors before deciding where to build a new nuclear power plant. The first step

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[17] *See* TENN. VALLEY AUTH., *supra* note 7; KY. REV. STAT. ANN. § 278.605 (LEXIS through 2016 Legis. Sess.) (repealed).

[18] *Building New Nuclear Facilities*, NUCLEAR ENERGY INST., https://www.nei.org/Issues-Policy/New-Nuclear-Energy-Facilities/Building-New-Nuclear-Facilities (last visited Sep. 5, 2017) [https://perma.cc/QSK2-JY4C].

[19] *Id.*

[20] *Id.*

[21] *Id.*

[22] *Id.*

is to find a state where nuclear plants are not banned and where taxpayers might even help foot the bill.[23] In Kentucky, though they are not banned, their waste is subject to extensive regulations.[24] It is also possible that taxpaying Kentuckians would be willing to help fund the establishment of a nuclear power plant, if it meant job creation and cheaper electric bills.

Another factor is topography. Building a nuclear reactor near a lake or river is best, since all reactors in the United States require water to operate.[25] Luckily, Kentucky boasts over thirty lakes and rivers across the state.[26] Due to the vast amount of space that nuclear power plants require to house outbuildings for ventilation equipment, storage for fuel and waste, parking lots, and computing facilities, at least 500 acres are needed to build a new nuclear power plant.[27] Areas experiencing population growth, and therefore, an increase in demand for power, are of top-priority for energy companies.[28]

Finally, to avoid publicity headaches, energy companies also consider community interest when selecting a new nuclear power plant location.[29] This final factor could be the most difficult for the state to overcome: many Kentuckians have deep roots in the coal industry and may not be supportive of a new one taking its place. Coal, however, has grown increasingly scarce and, consequently, cost prohibitive. The rapid growth in the demand

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[23] Lydia DePillis, *A Nuclear Power Plant With a View*, SLATE (Jul. 21, 2009, 2:37 PM), http://www.slate.com/articles/news_and_politics/explainer/2009/07/a_nuclear_power_plant_with_a_view.html [https://perma.cc/ABZ7-ZN9V].

[24] *State Restrictions on New Nuclear Power Facility Construction*, NAT'L CONF. OF ST. LEGIS. (Apr. 2016), http://www.ncsl.org/research/environment-and-natural-resources/states-restrictions-on-new-nuclear-power-facility.aspx#ky [https://perma.cc/G67X-HZRT].

[25] DePillis, *supra* note 24.

[26] *See Lakes & Rivers*, KY. TOURISM, http://www.kentuckytourism.com/explore/lakes_rivers.aspx (last visited Sep. 5, 2017) [https://perma.cc/4XQ2-YA93].

[27] DePillis, *supra* note 24.

[28] *Id.*

[29] *Id.*

for affordable energy may be enough soften the stance Kentuckians.

This demand is growing not only in Kentucky, but across the globe. To satisfy demand while fossil fuels disappear, states are turning to alternative forms of energy. In comparing energy generated in the U.S. in 2016, World Nuclear found that of the 4079 net TWh (terawatt hours, or one billion kWh), 1240 TWh (thirty percent) came from coal, 1380 TWh (thirty-four percent) from gas, 805 TWh (19.7 percent) from nuclear, 266 TWh from hydro, and 117 TWh from other renewables.[30] Nuclear power plays a major role. To get an idea of how big a role nuclear power plays, World Nuclear explains that there are ninety-nine nuclear power reactors across thirty states accounting for twenty percent of total electricity generated.[31] Clearly, despite new construction of nuclear power plants being stifled for nearly thirty years, the United States has begun to rely heavily on nuclear energy.[32] To get an idea of the country's reliance, history is important. World Nuclear compares the past to the future use of nuclear energy, stating:

> In 1980, nuclear plants accounted for eleven percent of the country's electricity generation. In 2008, that output had risen to nearly 20 percent of electricity, providing more than 30 percent of the electricity generated from nuclear power worldwide.[33]

The United States has turned to nuclear energy and begun to rely on it over the last several decades as the population continues to grow, and the abundance of fossil fuels continues to dwindle.

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[30] *Nuclear Power in the USA*, WORLD NUCLEAR, http://www.world-nuclear.org/information-library/country-profiles/countries-t-z/usa-nuclear-power.aspx (last updated Aug. 2017) [https://perma.cc/CFS9-SR9U].

[31] *Id.*

[32] *See id.*

[33] *Id.*

The benefits of using nuclear energy are numerous. According to Environmentalists for Nuclear Energy, "Nuclear power is clean, safe, reliable, compact, competitive, and practically inexhaustible."[34] Also, nuclear energy produces extremely minimal amounts of carbon dioxide, sulfur dioxide, and nitrogen oxides.[35] Alternatively, these gasses are produced in mass quantities when fossil fuels are burned.[36]

Regarding safety, the U.S. Bureau of Labor Statistics has shown that it is safer to work at a nuclear power plant than in the manufacturing sector, financial sector, and the leisure and hospitality industries.[37] In 2015, nuclear power plants had 0.03 industrial safety accidents per 200,000 worker–hours.[38] Many people are quick to dismiss nuclear power due to past incidents like the one at Chernobyl. Few, however, are aware of the increased safety measures now in place. For example, at Pennsylvania's Three Mile Island plant, when the reactor core melted down and fell to the bottom of the concrete reactor vessel, the containment structure captured nearly all of the released radioactivity (the amount that escaped was innocuous).[39] Chernobyl completely differs from Three Mile Island: not only were there no containment structures surrounding the reactors, but also security measures were completely bypassed.[40]

Moreover, fossil fuel industries have produced far more fatalities than the civilian nuclear power industry has, including Chernobyl, in the past fifty years.[41] Over 5 thousand mining

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[34] Bruno Comby, *The Benefits of Nuclear Energy*, ENVIRONMENTALISTS FOR NUCLEAR, http://ecolo.org/documents/documents_in_english/BENEFITS-of-NUCLEAR.pdf (last visited Sept. 12, 2017) [https://perma.cc/MDU2-PT7B].

[35] *Id.*

[36] *Id.*

[37] *Safety: The Nuclear Energy Industry's Highest Priority*, *supra* note 12.

[38] *Id.*

[39] *See* Bruno Comby, *The Benefits of Nuclear Energy*, ENVIRONMENTALISTS FOR NUCLEAR, http://ecolo.org/documents/documents_in_english/BENEFITS-of-NUCLEAR.pdf (last visited Sep. 4, 2017) [https://perma.cc/KM4B-E47L].

[40] *Id.*

[41] Comby, *supra* note 40.

(including coal) injuries and fatalities are reported each year.[42] Accordingly, with the implementation of greater safety measures and staff staffing, nuclear power is safer than the public may believe.

If an injury were to occur from nuclear radiation, however, the Price-Anderson Act also provides protection for Americans. The Center for Nuclear Science and Technology Information (CNSTI) states, "The main purpose of the Price-Anderson Act is to ensure the availability of a large pool of funds to provide prompt and orderly compensation of members of the public who incur damages from a nuclear or radiological incident no matter who might be liable."[43] Coverage provided by the act extends to any persons who may be legally liable, regardless of their relationship to the licensed activity.[44] Notably, this was the same protection that covered licensees and contractors received.[45] The CNSTI reported that "In the [forty-three] years of Price-Anderson protection, the nuclear insurance pools have paid a total of 151 million [dollars] for claims, while the Department of Energy has paid about 65 million [dollars] during this same period."[46]

Perhaps Americans would be more receptive to nuclear power if they understood how nuclear power was created. Similar to other power plants that burn coal, oil, and natural gas, nuclear power plants produce electricity by boiling water and turning it into steam.[47] To generate the electricity, the steam rises and turns turbines.[48] The difference between nuclear power plants and other energy sources is that nuclear plants do not actually burn anything.[49] Instead, they produce electricity through a

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[42] The National Institute for Occupational Safety and Health, *Coal Industry Sector*, CDC, https://www.cdc.gov/niosh/mining/statistics/CoalSector.html (last updated Apr. 11, 2017) [https://perma.cc/Q38C-WP7T].

[43] The Price-Anderson Act, CTR. FOR NUCLEAR SCI. AND TECH. INFO. (Nov. 2005), http://www.ans.org/pi/ps/docs/ps54-bi.pdf [https://perma.cc/3QHN-DRW7].

[44] *Id.*

[45] *Id.*

[46] *Id.*

[47] *How Nuclear Reactors Work*, NUCLEAR ENERGY INST., https://www.nei.org/Knowledge-Center/How-Nuclear-Reactors-Work (last visited Sept. 4, 2017) [https://perma.cc/X5XJ-26B7].

[48] *Id.*

[49] *Id.*

process called fission, using uranium fuel (i.e., solid ceramic pellets).[50] The Nuclear Energy Institute explains the process of fission:

> Nuclear fuel consists of two types of uranium, U-238 and U-235. Most of the uranium in nuclear fuel is U-238, but U-235 splits—or fissions—easily. In U-235 atoms, the nucleus, which is composed of protons and neutrons, is unstable. As the nuclei break up, they release neutrons. When the neutrons hit other uranium atoms, those atoms also split, releasing neutrons of their own, along with heat. These neutrons strike other atoms, splitting them. One fission triggers others, which triggers still more until there is a chain reaction. When that happens, fission becomes self-sustaining. Rods inserted among the tubes holding the uranium fuel control the nuclear reaction. Control rods, inserted or withdrawn to varying degrees, slow or accelerate the reaction. Water separates fuel tubes in the reactor, and the heat produced by fission turns this water into steam. The steam drives a turbine, which spins a generator to create electricity.[51]

Reviewing this process, it is easy to see how relatively safe and clean the creation of nuclear energy can be.

Beyond cleanliness and safety, nuclear power is also relatively cheap to produce, and creates energy with a higher density and base load that is more sustainable than fossil fuels. Though the initial building costs are high, running costs are low.[52] In total, it costs from 6 to 9 billion dollars to build a nuclear

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[50] *Id.*
[51] *Id.*
[52] *See* NUCLEAR ENERGY INST., *supra* note 12.

power plant.[53] Nuclear power plants also provide a stable base load of energy.[54] This base load of energy can work alongside renewable energy sources (e.g., wind and solar), which can be lowered when renewable resources are available, and raised when they are not.[55] Most reactors have a life span of forty years, but many are granted forty to sixty year extensions if still in good condition.[56] Nuclear energy is not considered a renewable resource, but it is potentially sustainable by the use of breeder and fusion reactors.[57] With extensive research and development in atomic fusion, we have the potential to create unlimited energy.[58]

Nuclear plants also create higher density energy than fossil fuels. In fact, the Energy Informative estimates that "the amount of energy released in a nuclear fission reaction is ten million times greater" than that released from burning fossil fuels.[59] Consequently, nuclear power plants require much less fuel than coal and other fossil fuel-burning power plants.[60] The benefits of nuclear energy are abundant.

But there are drawbacks. Beyond the possibilities for accidents and high startup costs, radioactive waste disposal is another concern with nuclear power. Several states, including Kentucky, have enacted legislation requiring the proper disposal and removal of radioactive waste from nuclear power plant sites.[61] Some have even enacted legislation requiring that nuclear

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[53] David Schlissel & Bruce Biewald, *Nuclear Power Plant Construction Costs*, SYNAPSE ENERGY 1, 2 (Jul. 2008), http://www.synapse-energy.com/sites/default/files/SynapsePaper.2008-07.0.Nuclear-Plant-Construction-Costs.A0022_0.pdf [https://perma.cc/A84R-PGDC].

[54] *See* NUCLEAR ENERGY INST., *supra* note 12.

[55] Mathias Aarre Maehlum, *Nuclear Energy Pros and Cons*, ENERGY INFORMATIVE, http://energyinformative.org/nuclear-energy-pros-and-cons (last updated May 3, 2013) [https://perma.cc/U8JJ-G7DQ].

[56] *Nuclear Power Reactors*, WORLD NUCLEAR ASS'N, http://www.world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-power-reactors/nuclear-power-reactors.aspx (last updated June 2017) [https://perma.cc/X88R-HV4T].

[57] Maehlum, *supra* note 60.

[58] *See id.*

[59] *Id.*

[60] *Id.*

[61] *See supra* note 18.

power plants have plans for waste disposal and removal before construction of a new plant may begin.[62] Though it may be time consuming to find a place to dispose of radioactive waste, the amount produced by nuclear power plants is much less than that produced by fossil fuels.[63] Possibly the final pitfall of nuclear energy is the extremely high startup cost. It costs upwards of $6 billion to establish a new nuclear power plant.[64] When considering financing for new energy sources, the Union of Concerned Scientists determined "Public financing for energy alternatives should be focused on fostering innovation and achieving the largest possible reduction in heat-trapping emissions per dollar invested—not on promoting the growth of an industry that has repeatedly shown itself to be a highly risky investment."[65] Cost being the biggest downfall to nuclear energy, a cost-benefit analysis must be observed before ruling out nuclear energy.

Energy alternatives to fossil fuels are expensive, but necessary in order to protect the environment and stay competitive in the ever-evolving world marketplace. Reducing startup costs, along with amending legislation that is preventing the construction of nuclear power plants, may be the best way to implement nuclear energy into states where no active reactors exist. Government subsidies for costs (startup and operating) would greatly reduce the burden on taxpayers to help foot the bill for nuclear power plants. Proper education regarding nuclear energy, and its safe practices could reduce fear stemming from past nuclear meltdowns. With more people heading into the workforce with knowledge of nuclear power, there would be more workers to take on the duties of starting up new nuclear power

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[62] *Id.*

[63] *See* Kharecha and Hansen, *supra* note 17.

[64] *See The Economics of Nuclear Power*, WORLD NUCLEAR, http://www.world-nuclear.org/information-library/economic-aspects/economics-of-nuclear-power.aspx (last updated Aug. 2017) [https://perma.cc/9XGT-ZW6C].

[65] *Nuclear Power Cost*, UNION OF CONCERNED SCIENTISTS, http://www.ucsusa.org/nuclear-power/cost-nuclear-power#.WBDHN2VbyFJ (last visited Sept. 29, 2017) [https://perma.cc/6GJB-XDBQ].

plants. Reducing our nation's energy footprint should be a top priority in the energy sector, as we continue to see signs of climate change. Shifting towards renewable and clean energy (including nuclear) would help reduce carbon emissions, lower greenhouse gas emissions, and effectively clean the air we breathe every day. Moving to a cleaner, safer, and more compact energy source would do wonders across the country, especially in Coal Country Kentucky.

II. NUCLEAR ENERGY VERSUS COAL IN KENTUCKY

If coal was to be replaced by nuclear energy in Kentucky, several concerns would arise: (1) job creation and replacement; (2) waste disposal; and (3) economic growth. Fortunately, however, neighbor states like Tennessee (which already has two nuclear power plants) have provided data that allows Kentucky to make informed projections. And, understandably, these projections indicate that eliminating coal mining would be a lengthy process for Kentucky, since it has provided jobs to residents for almost two centuries.[66]

Coal production and employment have been on the decline across the country for decades. According to Kentuckians for the Commonwealth, coal mining in Kentucky provides about 18,000 jobs across the state, which is down from around 48,000 thirty years ago.[67] These jobs are essential to the workers residing in local Kentucky communities. They tend to pay well and are often concentrated in counties with few economic alternatives.[68] The funds generated through the coal severance tax and unmined minerals tax provides a crucial source of revenue for eastern Kentucky counties and school systems.[69] In 2015, however, U.S.

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[66] *See Kentucky History – Coal*, KENTUCKY COAL EDUC., http://www.coaleducation.org/coalhistory (last visited Sept. 10, 2017) [https://perma.cc/ZW6Z-EARG].

[67] *Coal Production and Employment Trends*, KENTUCKIANS FOR THE COMMONWEALTH, http://kftc.org/campaigns/appalachian-transition/coal-production-and-employment-trends (last visited Sept. 10, 2017) [https://perma.cc/L5G5-KXHQ].

[68] *Id.*

[69] *Id.*

coal production dropped 10.3 percent, year-over-year, to below 900 million short tons—the lowest annual production level since 1986.[70] 2015 was the fourth consecutive year where the productivity capacity of U.S. coal mines decreased—a decline of 6.3 percent from the previous year.[71] The Energy Information Administration reported that the average number of employees in coal mines across the country has decreased to 65,971 employees, which is the lowest on record.[72] In Kentucky, jobs decreased in one quarter from approximately 11,586 to 10,356.[73] Accordingly, more than one in ten coal mining jobs were lost in Kentucky during the first quarter of 2015.[74]

Job creation is perhaps the most important factor to consider when contemplating replacing coal with nuclear energy. The average unemployment rate in Eastern Kentucky in 2016 was approximately 10.8 percent.[75] This rate was about double the statewide and national averages, approximately 4.84 and five percent respectively.[76] The mining and logging job category saw a decrease in employment by an average of over 18 percent in 2016.[77] But if a new nuclear power plant, comparable to TVA's Watts Bar II in Tennessee, were to be built, then between 3 and 5 thousand construction related jobs and about 600 to 800

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[70] *Annual Coal Report*, U.S. ENERGY INFO. ADMIN. (Nov. 3, 2016), http://www.eia.gov/coal/annual/ [https://perma.cc/5JW2-GL8W].

[71] *Id.*

[72] *Id.*

[73] *See* Bill Estep, *Report: Kentucky Lost More than 1 in 10 Coal Jobs During First Three Months of 2015*, LEXINGTON HERALD LEADER (Apr. 30, 2015), http://www.kentucky.com/news/business/article44597049.html [https://perma.cc/YGR5-2KWM].

[74] *See Id.*

[75] *See Eastern, KY Unemployment Rate Report*, HOMEFACTS, http://www.homefacts.com/unemployment/Kentucky/Floyd-County/Eastern.html (last visited Sep. 4, 2017) [https://perma.cc/S2TC-NR8X].

[76] *See id.*

[77] *See Databases, Tables, and Calculators by Subject*, BUREAU OF LABOR STATISTICS, https://data.bls.gov/timeseries/LASST210000000000003?amp%253bdata_tool=XGtable&output_view=data&include_graphs=true (data extracted on Sep. 4, 2017, 5:09:15 PM) [https://perma.cc/Q43F-DHP5].

permanent high-paying jobs would be created.[78] Local communities with nuclear power plants see an economic impact of about 470 million dollars on average.[79] The ninety-nine nuclear reactors in the U.S. generate from forty to fifty billion dollars annually in electricity sales, with over 100 thousand workers contributing to production.[80] Each nuclear power plant employs approximately 530 employees,[81] and for every 100 of those jobs at a nuclear energy facility, there are another 726 jobs produced that are related to the industry throughout America.[82] Accordingly, establishment of a nuclear power plant would outrun coal mining in terms of job creation for the residents of Kentucky.

Comparing amounts of waste between coal and nuclear energy is an additional factor to consider when contemplating replacing coal with nuclear energy. Radioactivity of nuclear waste is concerning for many residents when nuclear power plant sites are proposed near residents' homes. As mentioned, however, this fear may be misplaced. The publication Scientific American provides that coal plant waste is more radioactive than nuclear power plant waste.[83] Fly ash from the burning of coal enters the surrounding area and emits 100 times more radiation than a nuclear power plant produces.[84] Furthermore, people living near

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[78] *Can Coal State Kentucky Embrace Nuclear Energy?*, NUCLEARSTREET.COM (Sep. 20, 2015), https://nuclearstreet.com/pro_nuclear_power_blogs/b/neutron-bytes/archive/2015/09/20/can-coal-state-kentucky-embrace-nuclear-energy#.Wa4ybmWBTII [https://perma.cc/JLZ7-YPEV].

[79] *Id.*

[80] *Economic Growth and Job Creation*, NUCLEAR ENERGY INST., https://www.nei.org/Why-Nuclear-Energy/Economic-Growth-Job-Creation (last visited Sep. 4, 2017) [https://perma.cc/US3P-7GTG].

[81] Doug Hardtmayer, *The New Great Compromise: Nuclear Energy's Broad Appeal*, AMERICAN NUCLEAR SOC'Y (Jul. 11, 2017), http://ansnuclearcafe.org/2017/07/11/the-new-great-compromise-nuclear-energys-broad-appeal-2/#sthash.X6WCbrmW.dpbs [https://perma.cc/CVK4-84DQ].

[82] *Id.*

[83] Mara Hvistendahl, *Coal Ash Is More Radioactive Than Nuclear Waste*, SCIENTIFIC AMERICAN (Dec. 13, 2007), https://www.scientificamerican.com/article/coal-ash-is-more-radioactive-than-nuclear-waste/ [https://perma.cc/6MDD-A6L3].

[84] *Id.*

coal plants ingest as much or even more radiation than those living near nuclear plants.[85]

Kentucky's abundant agriculture industry is put directly at risk due to the radiation generated by this fly ash, as radiation doses in food grown near coal plants are fifty to 200 percent higher than nuclear plants.[86] Nuclear radioactive waste is small by comparison; it is about a million times smaller than fossil fuel waste and, consequently, far less harmful.[87] For example, "a typical French family's use of nuclear energy over a whole lifetime produces vitrified waste the size of a golf ball."[88] Nuclear waste is stored deep in the earth, and dissolves over time; waste from coal plants, however, goes up directly into the biosphere through the smokestacks and damages the environment.[89] Nuclear beats coal in every category when it comes to waste.

Post operation, the process of decommissioning a nuclear plant is more highly regulated than that of a coal plant. Federal regulations require nuclear power plants to be safely deconstructed and restored to a near-greenfield status.[90] Justin Gundlach states about the decommissioning process: "The decommissioning process and its costs are elaborately routinized, but recurrent discoveries of unexpected environmental degradation at reactor sites ensure that the nature and cost of reactor decommissioning and site remediation will remain at least somewhat uncertain."[91] Meanwhile, regulations on the decommissioning of coal mines are more relaxed, allowing manufacturers to leave former mine sites without the

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[85] *Id.*

[86] *See id.*

[87] Bruno Comby, *The Benefits of Nuclear Energy*, ECOLO.ORG, http://ecolo.org/documents/documents_in_english/BENEFITS-of-NUCLEAR.pdf (last visited Sep. 4, 2017) [https://perma.cc/D7F2-A2W9].

[88] *Id.*

[89] *See id.*

[90] *See* Justin Gundlach, *What's the Cost of a New Nuclear Power Plant? The Answer's Gonna Cost You: A Risk-Based Approach to Estimating the Cost of New Nuclear*, 18 N.Y.U. ENVTL. L.J. 600, 640-641 (2011).

[91] *Id.*

requirement of total restoration.[92] Regulations on restoration of decommissioned nuclear plants would prevent Kentucky's land from being left scarred and barren.

Moving toward nuclear energy and away from coal is a way for Kentucky to grow its economy and boost state revenue. Mining, generating, and managing coal waste is becoming increasingly expensive.[93] But, in the meantime, Kentucky's neighboring states boast an increase in jobs created through renewable energy.[94] Governmental overreach, through restrictive legislation on renewable energy could be costing Kentucky jobs.[95] Although Kentucky is not completely keen on renewable energy, it is starting to encourage green manufacturing ahead of its renewable energy market.[96] Subsequently, the state has received millions in federal stimulus funds from the U.S. Department of Energy to distribute clean energy tax credits and grants.[97]

Nuclear energy also pumps money back into local communities. Generally, according to the Nuclear Energy Institute, a typical nuclear power plant generates around $470 million from the sales of goods and services in the surrounding community and around $40 million in labor income.[98] In fact, each dollar spent at a nuclear power plant amounts to an investment of $1.04 in the local community, $1.18 in the state, and $1.87 in the nation.[99] Annually, a single nuclear plant can generate up to 16 million dollars in state and local tax revenue.[100] Schools, roads, and other forms of infrastructure benefit from this nuclear-generated tax revenue. [101] For comparison, coal generated around 528 million dollars in state revenues, and

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[92] *See* KY. REV. STAT. ANN. § 350.405 (LexisNexis 1978, Lexis Advance through 2016 Legis. Sess.).

[93] Galluci, *supra* note 16.

[94] *Id.*

[95] *See id.*

[96] *Id.*

[97] *Id.*

[98] *Costs & Benefits Analyses*, NUCLEAR ENERGY INST., https://www.nei.org/Issues-Policy/Economics/Cost-Benefits-Analyses (last visited Sept. 5, 2017) [perma.cc/HD85-8NAQ].

[99] *Id.*

[100] *Id.*

[101] *Id.*

about 643 million dollars in state expenditures in Kentucky.[102] But with the decline of coal in recent years, these figures are decreasing despite expenditures staying the same. Nuclear has the potential to boost Kentucky's state revenues and overall economy.

A nuclear power plant in Kentucky would work wonders for the Commonwealth. Both initial plant construction and continued operation would provide thousands of jobs to residents across the state. A nuclear power plant could help reduce Kentucky's carbon footprint and boost the state's revenue by millions of dollars. This revenue could help fund education, healthcare, infrastructure, and many other departments that have suffered budget cuts. Moving away from costly coal to clean nuclear energy would give life to Kentucky's communities.

III. EFFECTS OF ESTABLISHING NUCLEAR ENERGY IN KENTUCKY AND THE ELIMINATION OF COAL

If coal replaced nuclear energy in Kentucky, residents would face many changes in their daily lives. Undoubtedly, rural families who have depended on coal for income would be forced to search for work in an abandoned community. As noted, however, Kentucky would see economic growth that would appear to outweigh this and other challenges. Moreover, coal-dependent communities will experience hardship even if the state does not begin the transition.

Kentucky is already currently facing a decline in coal-fired electricity generation unlike anything residents have previously experienced. Coal-fired power plants have routinely produced more than nine-tenths of Kentucky's net electricity generation; however, in 2016, coal accounted for less than nine-tenths of net generation, for the first time in decades, while natural gas-fired

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[102] *The Impact of Coal on the Kentucky State Budget*, THE MOUNTAIN ASS'N FOR COMMUNITY ECON. DEV., http://www.maced.org/coal/exe-summary.htm (last visited Sept. 5, 2017) [perma.cc/8NXQ-LBGW].

electricity production tripled from the previous year.[103] However, coal still generated the majority of Kentucky's electricity.[104] The other sources of Kentucky's electricity are hydroelectric power and biomass.[105] From 2014 to 2016, 12 percent of Kentucky's coal-fired electricity generating capacity was shut down.[106] A total of nearly 2,800 megawatts of coal-fired generating capacity in the state has been retired or is scheduled to be retired between 2012 and 2025.[107] As coal is disappearing from the mountains of Eastern Kentucky, so are the people from the communities their families have lived in for generations.

Coal, a sort of pseudo religion, has deep roots in Kentucky's culture. A "friends of coal" campaign can be seen on license plates throughout the state.[108] Families in Kentucky have depended on coal for over a century.[109] The lack of jobs and opportunity in "Coal Country," however, are forcing natives to pull up their roots.[110] Schools in areas like Pike county are struggling to provide quality education, if not stay open, due to the dwindling population and lack of school funding.[111] Accordingly, coal communities need to change their economies to survive.[112] This will be difficult, however, as government funding for coal mining continues to shrink and people in these rural areas are still relying on coal.[113]

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[103] *See Kentucky State Profile and Energy Estimates*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/state/analysis.cfm?sid=KY (last updated May. 18, 2017) [perma.cc/VCX9-C9U4].

[104] *Id.*

[105] *Id.*

[106] *Id.*

[107] *Id.*

[108] *See Governor Beshear Announces Than More Than 50,000 "Friends of Coal" License Plates Have Been Purchased in Three Years*, BUS. WIRE (Mar. 14, 2012, 4:43 PM), http://www.businesswire.com/news/home/20120314006568/en/Governor-Beshear-Announces-50000-Friends-Coal-License [perma.cc/DZ8Y-K6J7].

[109] *See* Bill Estep, *100 Years of Coal Mining in Harlan County*, LEXINGTON HERALD LEADER (Aug. 21, 2011, 5:27 AM), http://www.kentucky.com/news/local/coal/article44121909.html [perma.cc/8T6U-EQKT].

[110] Rick Cohen, *Helping People in "Coal Country" as the Nation Divests from Carbon*, NONPROFIT Q. (Oct. 3, 2014), https://nonprofitquarterly.org/2014/10/03/helping-people-in-coal-country-as-the-nation-divests-from-carbon/ [perma.cc/87Z8-B8M4].

[111] *Id.*

[112] *See id.*

[113] *Id.*

Lack of revenue production in Eastern Kentucky and other Appalachian towns is resulting in budget cuts that essentially choke the local communities. *Businessweek* recently wrote that the cuts stemmed from cheap natural gas prices and a steep drop in coal production.[114] While the cheapest and best coal has already been dug up, the remaining seams are more difficult and expensive to mine.[115] Consequent budget cuts are affecting people's everyday lives. In Letcher County, the current average response time of sheriff's deputies is around an hour, compared to an average of thirty minutes from 2014-2015.[116] Since the summer of 2015, Martin County has not been able to open its public swimming pool due to associated costs.[117] These and other similar conditions resulting from lost revenue "comes from a drop in payments known as severance taxes."[118] These are payments "mining companies paid into state coffers based on the value of coal tonnage taken from the earth."[119] The severance money that was paid to Kentucky counties decreased from $62 million dollars in 2010 to 23.4 million dollars in 2015.[120] These drops in revenue are causing residents to flee the area.

Kentucky's population is expected to increase by 10.4 percent despite seventy-nine of its counties facing a decline by 2040.[121] Eastern Kentucky holds three of the top-five counties expected to experience population decline during that time: Leslie, Breathitt, and Knott.[122] Each of these three counties are

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[114] Margaret Newkirk, Tim Loh, & Mario Parker, *Coal's Decline is Choking Appalachia Towns*, BLOOMBERG BUSINESSWEEK (Sept. 10, 2015), https://www.bloomberg.com/news/articles/2015-09-10/coal-s-decline-is-choking-appalachia-towns [https://perma.cc/TD9F-UJVD].

[115] *Id.*

[116] *Id.*

[117] *Id.*

[118] *Id.*

[119] *Id.*

[120] *Id.*

[121] Kassidy Stricklett, *Population of several Eastern Kentucky counties expected to decline*, WYMT (Oct. 27, 2016, 6:29 PM) http://www.wymt.com/content/news/Population-of-several-Eastern-Kentucky-counties-expected-to-decline--398949911.html [https://perma.cc/ZJ27-G9LP].

[122] *Id.*

facing a twenty-five percent drop in their residential population.[123] Knott county is projected to see a 29.5 percent decrease in population, with numbers falling from 15 thousand in 2015 to only 11 thousand by 2040.[124] The downfall of the coal industry could be the main reason for the population decline.[125]

Not only does the decline of coal have an impact on the economy of rural Kentuckians, but coal also poses major health concerns for those living in Appalachia. Surface mining and mountaintop removal release toxic dust into the atmosphere, affecting the people and the landscapes near the mines.[126] *Appalachian Voices* determined that in 2014, "toxic dust from mountaintop removal promote[d] the growth of lung cancer cells in people living nearby."[127] In recent years, coal mining Appalachian communities have faced an astonishing increase in cancer diagnoses compared to the national average.[128] Devastatingly, mountaintop removal has caused over 60 thousand of those cancer diagnoses.[129] The toxic particles that float in the air from heavy mining in the Appalachian area lead to lung cancer, respiratory diseases, heart attacks, cardiovascular diseases, and, consequently, shortened lives.[130]

Meanwhile, unlike coal production, nuclear power plant emissions that occur during regular operation are not harmful to residents nearby.[131] The United States Nuclear Regulatory Commission asserts that even in the unlikely event of a nuclear power plant accident, it is even more unlikely that a person would be in the area long enough to receive a lethal dose of

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[123] *Id.*

[124] *Id.*

[125] *See id.*

[126] *See Human Health Impacts*, APPALACHIAN VOICES, http://appvoices.org/end-mountaintop-removal/health-impacts/ (last visited Sept. 11, 2017) [https://perma.cc/9HDY-M7WE].

[127] *Id.*

[128] *Id.*

[129] *Id.*

[130] *See id.*

[131] *Frequently Asked Questions About Radiation Protection*, UNITED STATES NUCLEAR REG. COMMISSION, https://www.nrc.gov/about-nrc/radiation/related-info/faq.html#14 (Last updated June 13, 2016) [https://perma.cc/JU49-5ZDZ].

radiation.[132] A decrease or removal of heavy mining in rural Kentucky, and replacement with clean nuclear energy would lead to healthier, living residents.

Population decline is a red flag for struggling communities. When no jobs are left for the residents of the community, they must flee to support their families. If a nuclear power plant were to be constructed within commuting distance of these struggling communities in Eastern Kentucky, there is a great possibility for the little towns to thrive. A nuclear power plant would bring life back to the abandoned coal towns in the state. Residents of the towns would be healthier because of decreased exposure to carbon emissions and other carcinogens released into the air from the coal mines and coal-fired power plants. Nuclear power plants have the potential to revive and restore Eastern Kentucky and give residents a new hope of staying where their families have lived for generations.

With a switch to nuclear power, Kentucky would be doing its part to help combat climate change. Human-caused air pollution and climate change are already difficult to attenuate, but in a world without nuclear power, it will be even more difficult to mitigate.[133] NASA stated that "This is fundamentally because historical energy production data reveal that if nuclear power never existed, the energy it supplied almost certainly would have been supplied by fossil fuels instead (overwhelmingly coal), which cause much higher air pollution-related mortality and greenhouse gas emissions per unit energy produced."[134] Also, that "Nuclear power prevented an average of [sixty-four] gigatonnes of CO2-equivalent (GtCO2-eq) net greenhouse gas emissions globally between 1971 and 2009."[135] Although nuclear energy poses several challenges, it must be retained and significantly expanded to combat the climate change effects that

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[132] *Id.*
[133] *Id.*
[134] *Id.*
[135] *Id.*

are perpetuated by the burning of fossil fuels.[136] The carbon gasses that these burning fossil fuels emit into our atmosphere are harmful, even though one may not be able to see these effects in their day-to-day life.

Due to coal's high carbon content, the burning of the fossil fuel is contributing greatly to the damage of our atmosphere. 3 million tons of methane, equal to sixty-eight million tons of carbon dioxide, one of the most harmful greenhouse gasses to our atmosphere, is released specifically by coal mining each year.[137] The NRDC claims that "Carbon dioxide emissions from coal combustion represented 24.5 percent of total U.S. greenhouse gas emissions in 2012."[138] Coal mining and burning of other fossil fuels is continuously damaging our planet, and Kentucky must take action by replacing coal with clean nuclear to prevent any future damage.

CONCLUSION

If Kentucky desires to move up the economic ladder with its neighboring states, it must replace coal production with nuclear power plants. Passing Senate Bill 89 is Kentucky's first step toward replacing coal. Replacing coal with nuclear power would mean jobs for Kentuckians who live in the poorest regions of the state, improvement in air quality, booming amounts of state revenue, a decrease in greenhouse gas emissions, and economic improvement in communities. Implementing nuclear power in Kentucky would allow the state to let go of coal and embrace clean nuclear energy with a promising future.

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[136] *Id.*

[137] Daniel A. Lashof, et. al., *Coal in a Changing Climate*, NRDC ISSUE PAPER (Feb. 2007), https://www.nrdc.org/sites/default/files/coalclimate.pdf [https://perma.cc/Q5CS-A684].

[138] *Id.*